US008842434B2

(12) **United States Patent**
Chen et al.

(10) **Patent No.: US 8,842,434 B2**
(45) **Date of Patent: Sep. 23, 2014**

(54) **HEAT DISSIPATION SYSTEM**

(75) Inventors: **Chien-An Chen**, Taipei (TW); **Kai-Yang Tung**, Taipei (TW)

(73) Assignee: **Inventec Corporation**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 261 days.

(21) Appl. No.: **13/409,965**

(22) Filed: **Mar. 1, 2012**

(65) **Prior Publication Data**

US 2013/0118710 A1 May 16, 2013

(30) **Foreign Application Priority Data**

Nov. 11, 2011 (TW) .... 100141272 A

(51) **Int. Cl.**

H05K 7/20 (2006.01)
F28D 15/00 (2006.01)
F25D 31/00 (2006.01)
F28D 21/00 (2006.01)
F28D 15/06 (2006.01)

(52) **U.S. Cl.**

CPC ***F25D 31/00*** (2013.01); ***F28D 15/00*** (2013.01); *F28D 2021/0028* (2013.01); *F28D 15/06* (2013.01)

USPC **361/698**; 361/689; 361/699; 361/701; 361/679.46; 361/679.53; 165/80.4

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,714,412	B1 *	3/2004	Chu et al.	361/699
7,050,299	B2 *	5/2006	Kondo et al.	361/689
7,408,775	B2 *	8/2008	Walz et al.	361/699
7,522,418	B2 *	4/2009	Ishimine	361/699
7,551,440	B2 *	6/2009	Belady et al.	361/699
7,641,101	B2 *	1/2010	Campbell et al.	228/183
7,944,694	B2 *	5/2011	Campbell et al.	361/699
8,199,504	B2 *	6/2012	Kashirajima et al.	361/700
8,441,789	B2 *	5/2013	Wu et al.	361/679.49
8,542,489	B2 *	9/2013	Arney et al.	361/701
2009/0009958	A1 *	1/2009	Pflueger	361/687

FOREIGN PATENT DOCUMENTS

TW I237174 8/2005

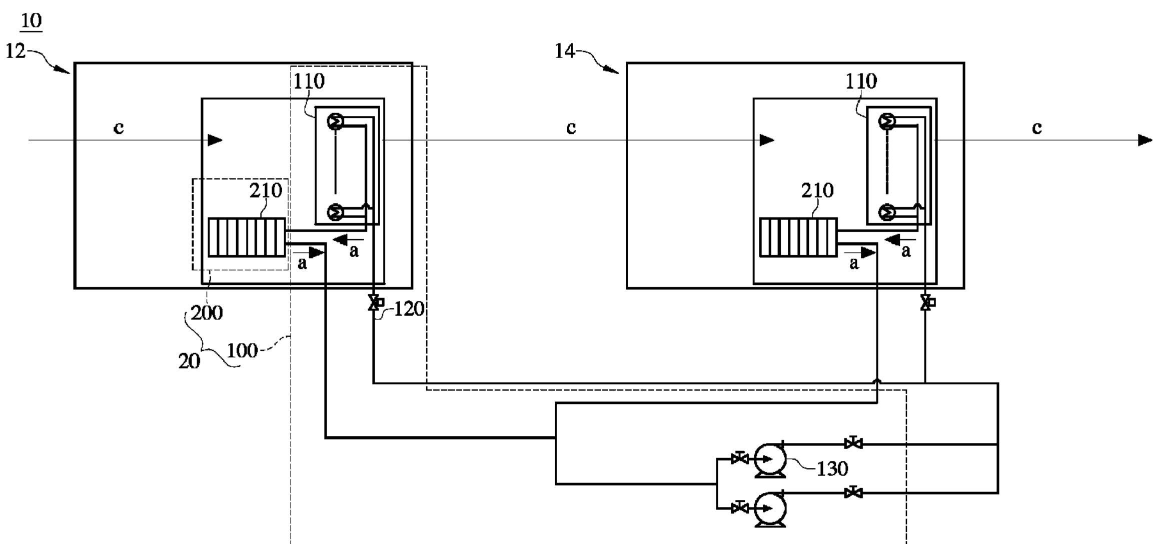
* cited by examiner

Primary Examiner — Boris Chervinsky
(74) *Attorney, Agent, or Firm* — Huffman Law Group, PC

(57) **ABSTRACT**

A server rack heat dissipation system for a server including an electronic component comprises a first and a second heat dissipation assembly. The first heat dissipation assembly includes a first heat exchanger and a first pipeline. The first heat exchanger is inside the server rack and in thermal contact with the electronic component. The first pipeline is in thermal contact with the first heat exchanger and has a first coolant. The second heat dissipation assembly includes a second heat exchanger. The second heat exchanger is inside the server rack and in thermal contact with the first pipeline. The second heat exchanger can remove the heat of the electronic component in the first coolant in advance. Accordingly, the time of the first coolant being maintained in a vapor phase can be shortened, so that a power the fluid driving device used for driving the first coolant is reduced.

18 Claims, 8 Drawing Sheets



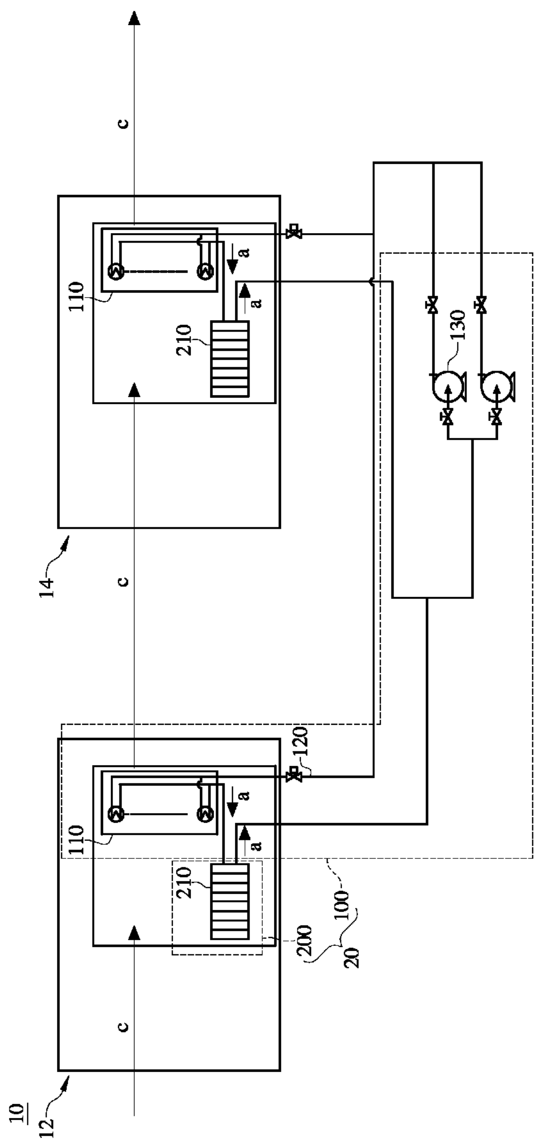


FIG.1

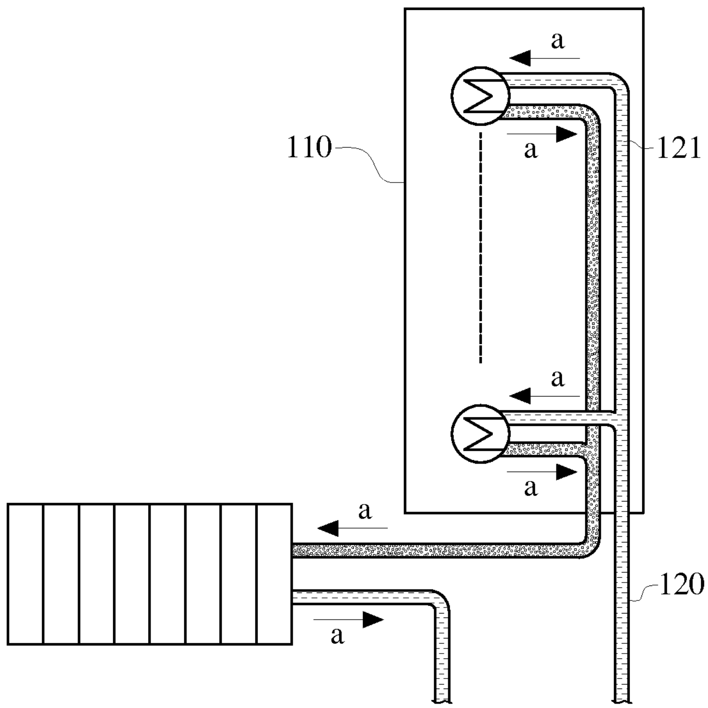


FIG.2

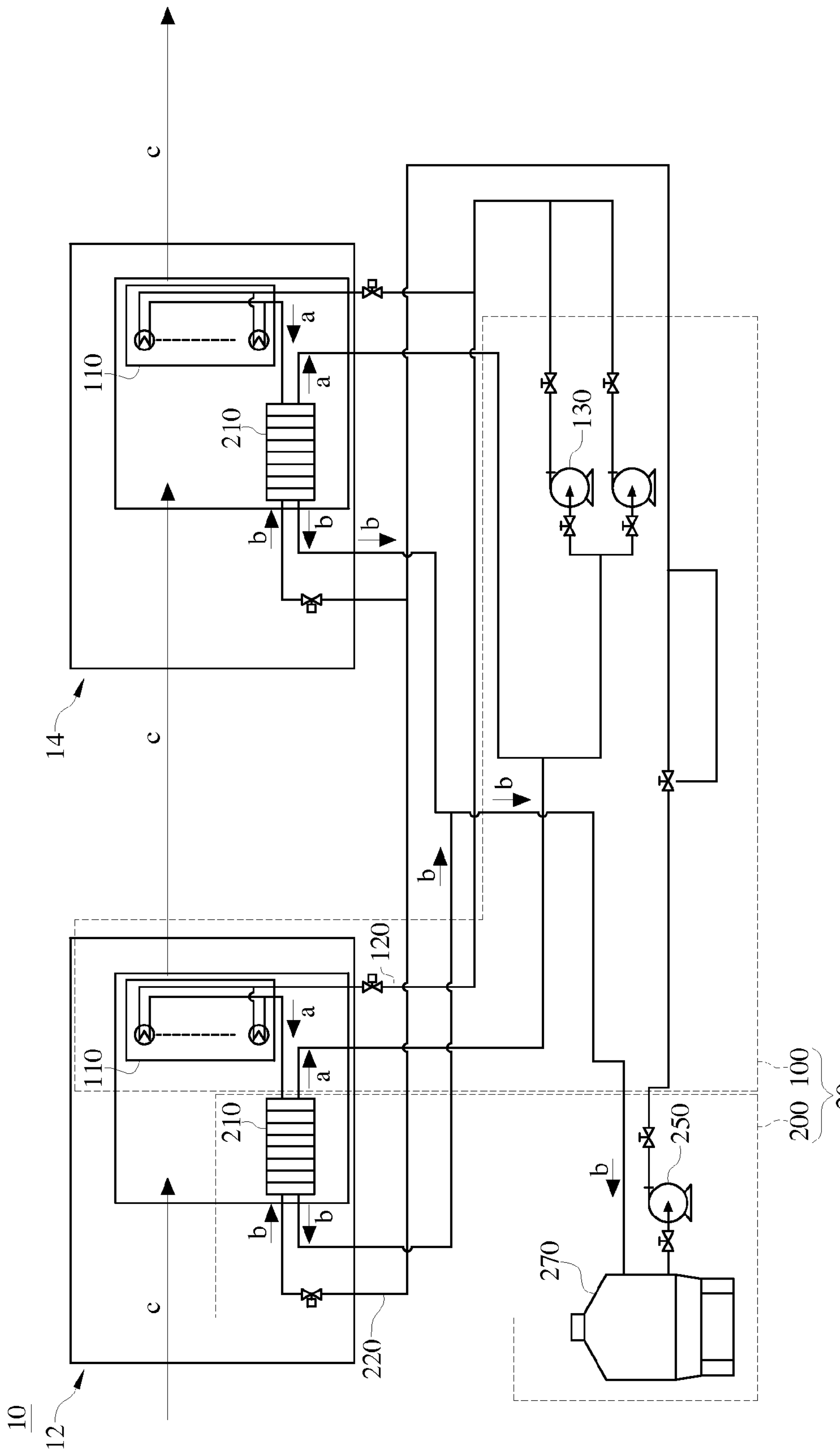


FIG.3

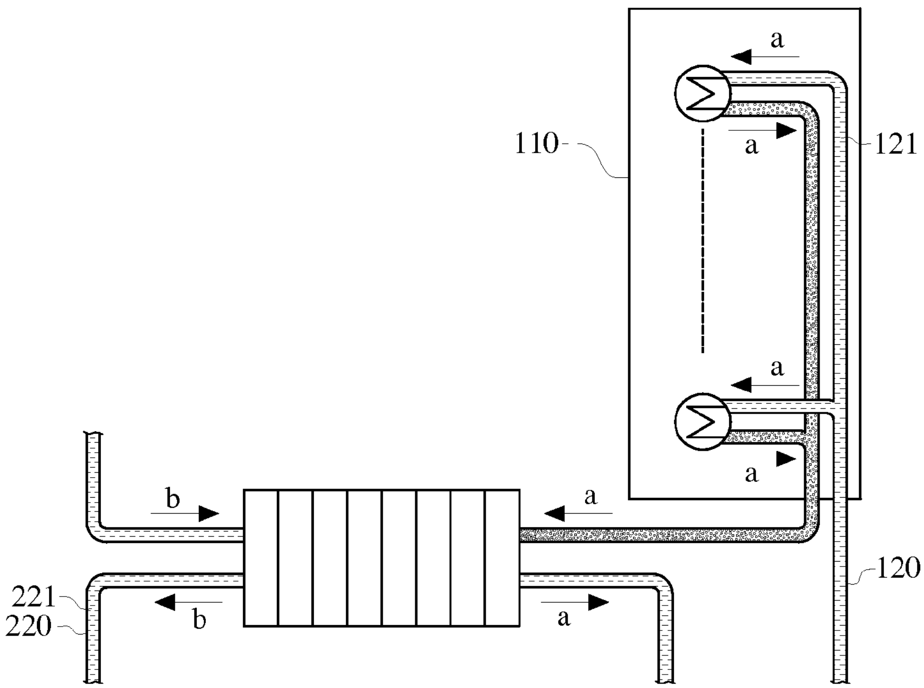


FIG.4

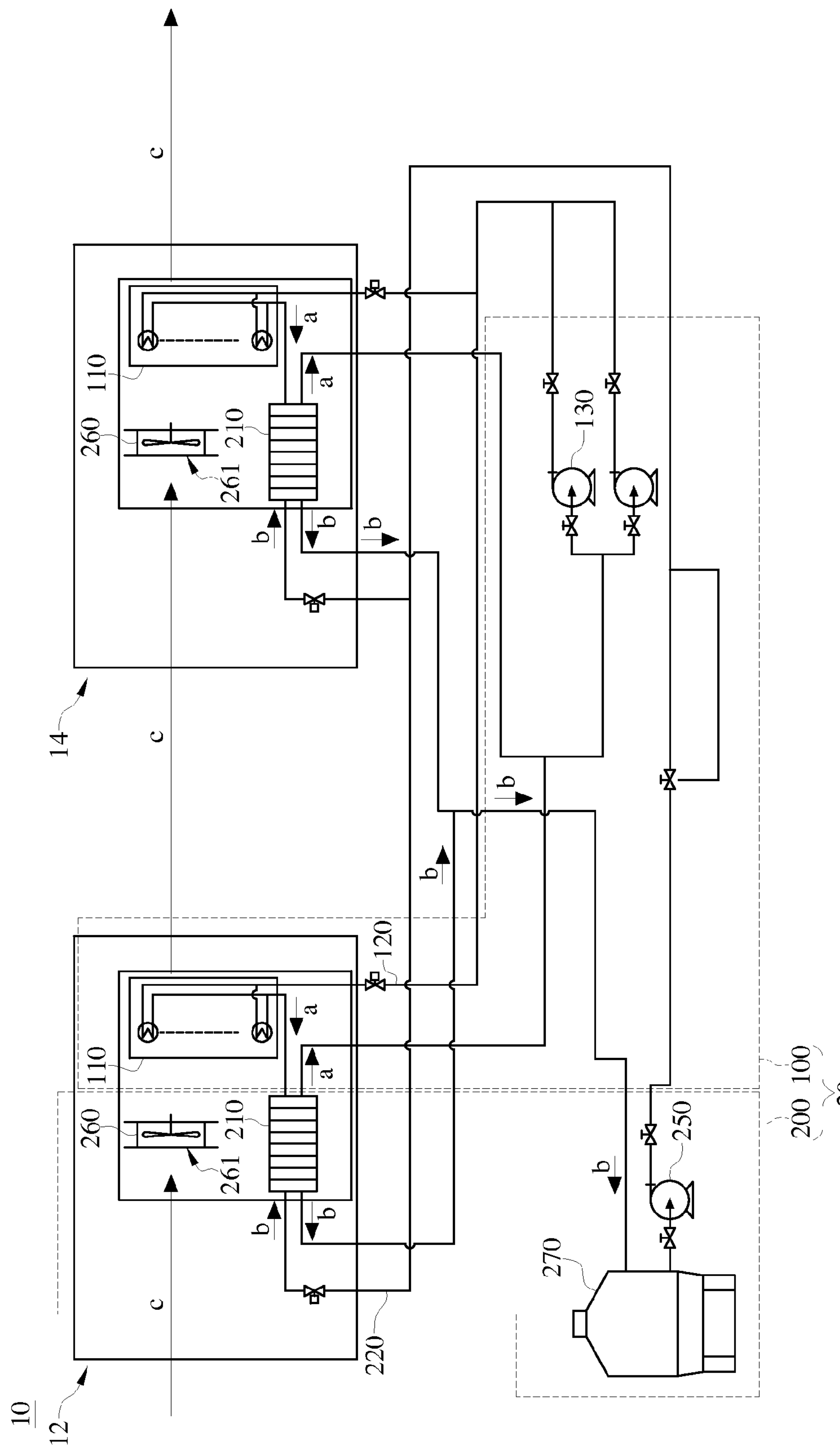


FIG.5

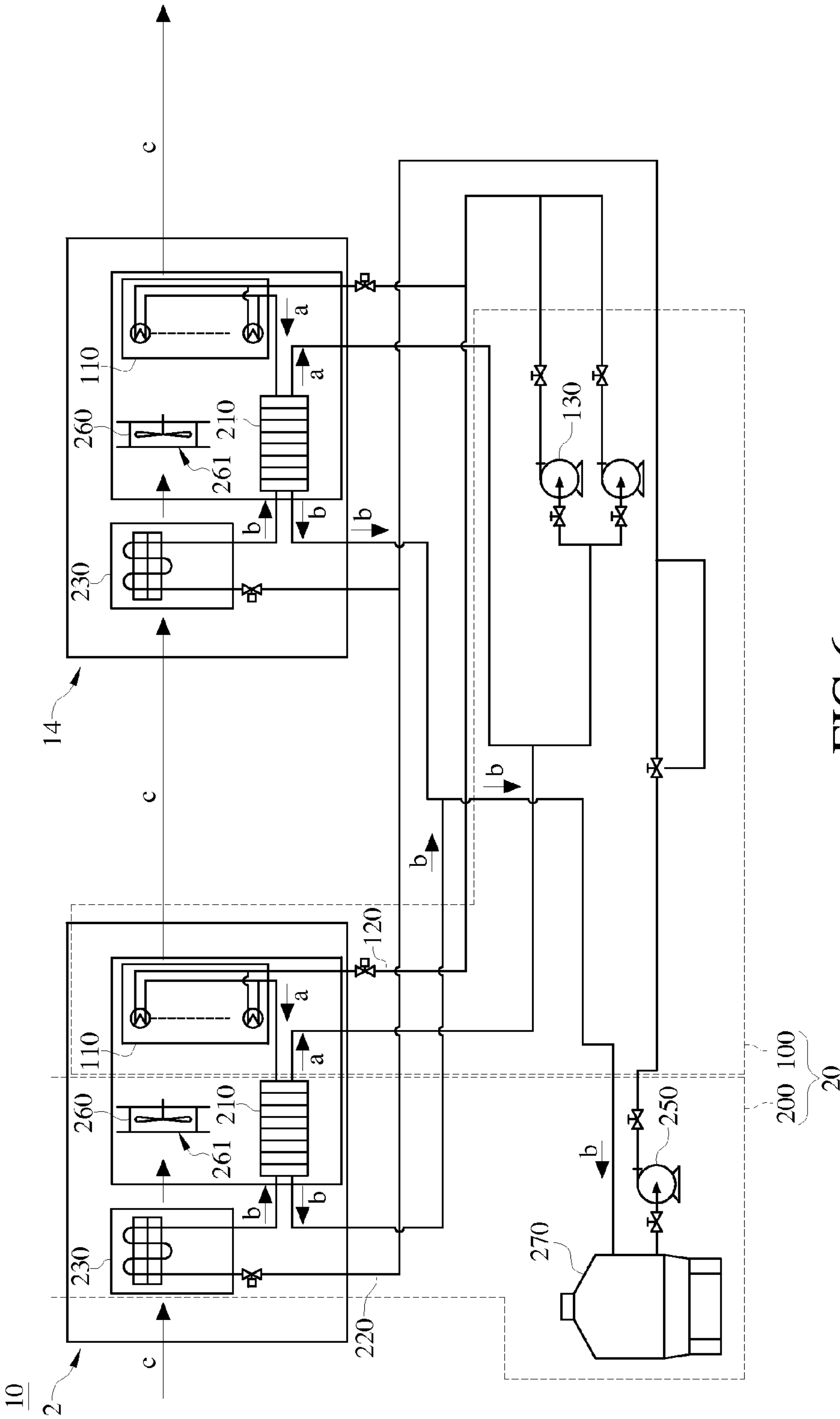


FIG.6

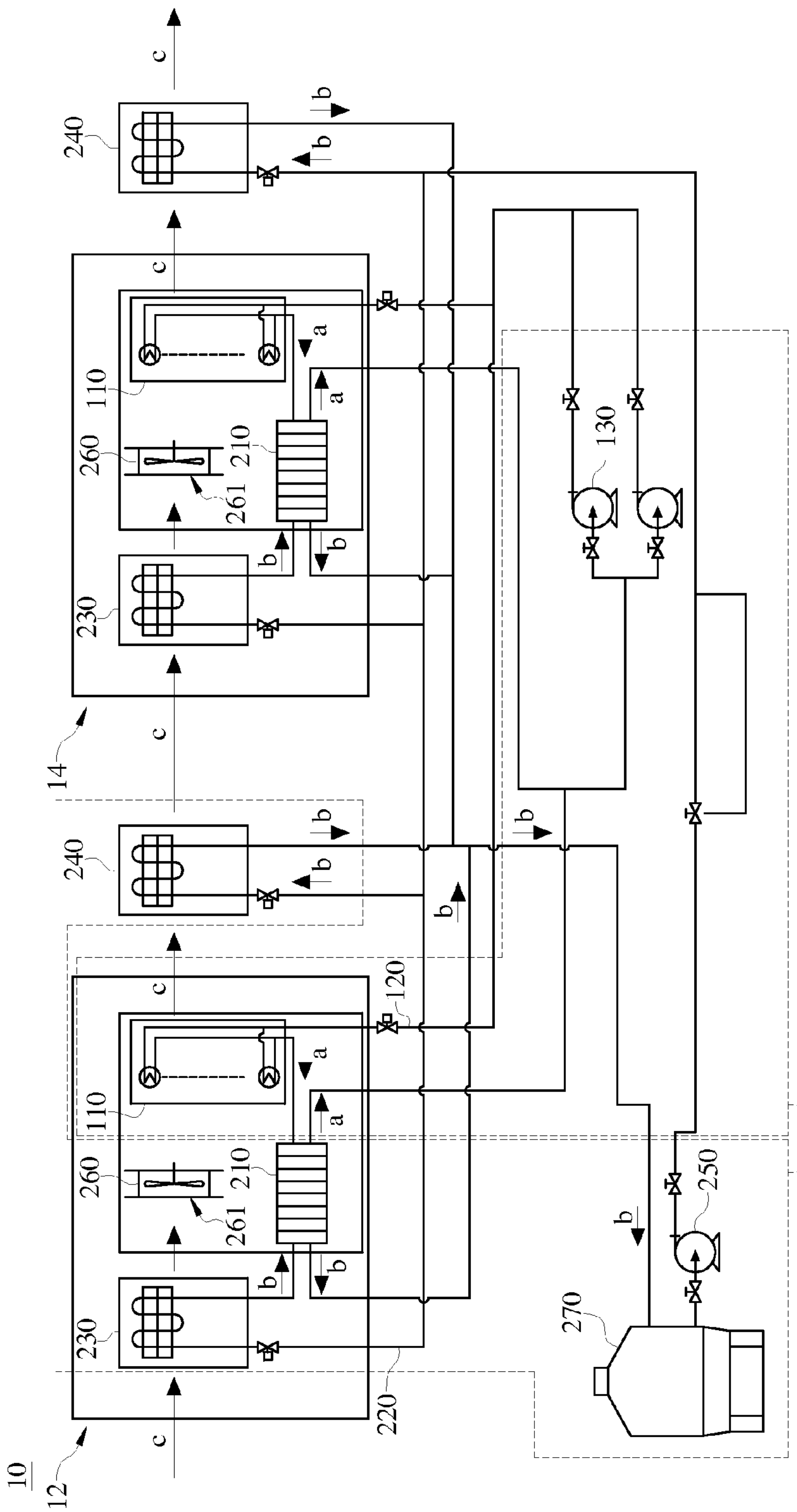

10
12
14
20
100
110
120
130
200
210
220
230
240
250
260
261
270
a
b
c

FIG.7

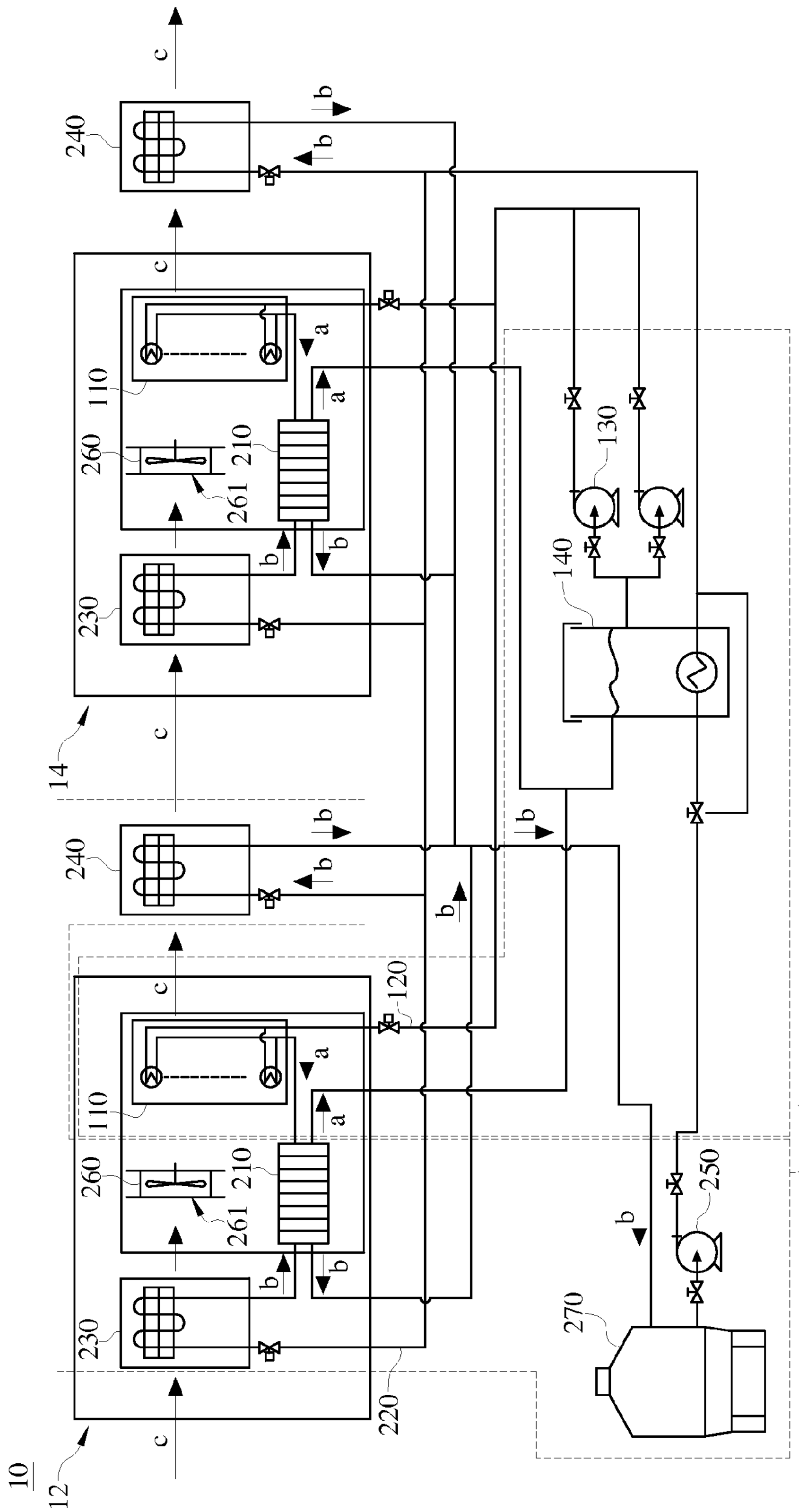

10
12
14
20
100
110
120
130
140
200
210
220
230
240
250
260
261
270
a
b
c

FIG.8

HEAT DISSIPATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This non-provisional application claims priority under 35 U.S.C. §119(a) on Patent Application No(s). 100141272 filed in Taiwan, R.O.C. on Nov. 11, 2011, the entire contents of which are hereby incorporated by reference.

BACKGROUND

1. Technical Field

The present disclosure relates to a heat dissipation system and more particularly to a heat dissipation system which is energy-efficient.

2. Related Art

Generally, electronic devices include desktop computer, laptop, tablet computer, personal digital assistant (PDA) and server, there are various types of electronic components inside an electronic device, and each electronic component has a temperature range within which it can operate normally. If the temperature of the electronic component exceeds the operating temperature range, it may operate abnormally, for examples the electronic device may be down or may be damaged due to the electronic component overheated. Fire may even breakout because of the overly high temperature. Therefore, most of the electronic devices employ heat dissipation modules, such as liquid cooling devices, in order to reduce the temperature of the electronic component. Thereby, the electronic component can be operated within the normal operating temperature range, so as to prevent the electronic component from operating abnormally.

The liquid cooling device has a pipeline, a radiator and a pump. The pipeline has a heat absorbing section and a heat dissipation section. The heat absorbing section is in thermal contact with an electronic component of the electronic device, and the heat dissipation section is in thermal contact with the radiator. Furthermore, there is a coolant inside the pipeline. When the pump drives the coolant to flow to the heat absorbing section, because the temperatures of the electronic components are higher than that of the heat absorbing section of the pipeline, the quantity of heat released by the electronic components will be conducted to the heat absorbing section of the pipeline. At this point, because the temperature of the coolant is lower than that of the pipeline, heat will be conducted from the pipeline to the coolant. Then, the temperature of the coolant increases because of the heat absorbed. Next, the coolant with a high temperature is sent to the heat dissipation section by the pump. Because the temperature of the coolant is higher than that of the radiator, the heat is released and conducted to the radiator through the pipeline so that the temperature of the coolant is lowered. Then the coolant with a reduced temperature will be sent back to the pump to complete a cooling cycle.

The abovementioned coolant can be maintained in single-phase without changes during the cooling cycle, and only the sensible heat of the coolant contributes to the cooling of the electronic component. Or, the abovementioned coolant can transform between liquid-phase and vapor-phase. In this case, the latent heat of the coolant absorbed during phase transition (i.e. changed from liquid phase to vapor phase) is involved to cool down the electronic component. The difference between the two lies in that the latent heat is a lot higher than the sensible heat.

However, even though the coolant is able to absorb a large quantity of heat released by the electronic components

through phase transition, the flow resistance between the gaseous coolant and the pipeline is a lot higher than that between the liquid coolant and the pipeline. Therefore, after the coolant is vaporized, larger power is consumed by the pump in order to drive the coolant to cycle inside the pipeline. Also, when there is too much gaseous coolant inside the pipeline causing excessive flow resistance between the coolant and the pipeline, a compressor of higher power consumption is required to drive the coolant to cycle inside the pipeline. Therefore, achieving balance between an efficiency of temperature reduction and power consumption of the heat dissipation system is a problem.

SUMMARY

In one aspect, a server rack heat dissipation system for a server rack that includes an electronic component comprises first and second heat dissipation assemblies. The first heat dissipation assembly includes a first heat exchanger and a first pipeline. The first heat exchanger is disposed inside the server rack and is in thermal contact with the electronic component. The first pipeline is in thermal contact with the first heat exchanger and has a first coolant. The second heat dissipation assembly includes a second heat exchanger also disposed inside the server rack and also in thermal contact with the first pipeline. When the heat dissipation system is in operation, the first coolant inside the first pipeline exchanges heat with the first heat exchanger, and then the first coolant inside the first pipeline exchanges heat with the second heat exchanger.

In another aspect, a data center heat dissipation system comprises first and second rack heat dissipation circuits and a first fluid driving device. The first rack heat dissipation circuit comprises a first pipeline carrying a first coolant and a first heat exchanger, in thermal contact with the first pipeline and an electronic component, that transfers heat from the electronic component to the first pipeline. A second heat exchanger is relatively proximate to the first heat exchanger and is also in thermal contact with the first pipeline. The second heat exchanger removes heat from the first pipeline. The first fluid driving device, relatively distal to the first and second heat exchangers, circulates the first coolant through the first pipeline. The second rack heat dissipation circuit comprises a second pipeline and a second fluid driving device circulating a second coolant that is isolated from the first coolant, wherein the first and second coolants do not mix. The second pipeline is also in thermal contact with the second heat exchanger for removing heat from the second heat exchanger. A third heat exchanger in thermal contact with the second pipeline is provided to remove and dissipate heat from the second pipeline. When the heat dissipation system is in operation, the first coolant circulates through the first pipeline to remove heat from the electronic component and transfer it to the second heat exchanger, and the second coolant circulates through the second circuit to remove heat from the second heat exchanger and transfer it to the third heat exchanger.

In yet another aspect, a method is provided of removing waste heat from electronic components in a server. The method comprises circulating first and second cooling fluids, respectively, through first and second heat dissipation pipeline circuits. The first heat dissipation pipeline circuit is in thermal contact with a pair of relatively proximately located first and second heat exchangers. The first heat exchanger is in thermal contact with an electronic component. The first rack heat dissipation circuit also includes a first fluid driving device located relatively distal of the pair of first and second heat exchangers. The second heat dissipation pipeline circuit is also in thermal contact with the second heat exchanger, so that the second cooling fluid removes heat from the second heat exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure will become more fully understood from the detailed description given herein below for illustration only, and thus are not limitative of the present disclosure, and wherein:

FIG. **1** is a flat illustration of a data center of a first embodiment;

FIG. **2** is an enlarged view of a first heat exchanger and a second heat exchanger of FIG. **1**;

FIG. **3** is a flat illustration of a data center of a second embodiment;

FIG. **4** is an enlarged view of a first heat exchanger and a second heat exchanger of FIG. **3**;

FIG. **5** is a flat illustration of a data center of a third embodiment;

FIG. **6** is a flat illustration of a data center of a fourth embodiment;

FIG. **7** is a flat illustration of a data center of a fifth embodiment; and

FIG. **8** is a flat illustration of a data center of a sixth embodiment.

DETAILED DESCRIPTION

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

In view of the abovementioned problem, some embodiments of the disclosure relate to a heat dissipation system to solve the problem that a high efficiency of temperature reduction is hard to be achieved while a low power consumption is pursued.

Referring to FIGS. **1** and **2**, wherein FIG. **1** is a flat illustration of a data center of a first embodiment, and FIG. **2** is an enlarged view of a first heat exchanger and a second heat exchanger of FIG. **1**. A data center **10** comprises a plurality of server racks, and each of the server racks includes at least one electronic component (not illustrated). A server rack is a standardized frame or enclosure for mounting equipment modules. For example, a server rack may, in one conventional rack server embodiment, correspond to a server rack. For convenience of description, two server racks, a first server rack **12** and a second server rack **14** respectively, are depicted in the drawings, but the invention is, of course, not limited to servers with two server racks. Each of the server racks **12** and **14** has at least one rack server.

The electronic component has an operating temperature range which is between an initial operating temperature of the electronic component and a preset upper temperature limit. For example, the preset upper temperature limit can be a temperature set for protecting the electronic component from crashes or a temperature set for avoiding the electronic component from being burned out. The electronic component can be, for example, an integrated circuit chip such as a central processing unit, a display card, a south-bridge and north-bride chipset or a memory. For convenience of description, a central processing unit is used as the electronic component in this embodiment; wherein, the operating temperature range of the central processing unit is, for example, between 30° C. and 80° C.

A server rack heat dissipation system **20** of this embodiment includes a first rack heat dissipation circuit or assembly **100**, a second rack heat dissipation circuit or assembly **200** and a fluid driving device **130** (such as a pump). The first heat dissipation assembly **100** includes at least one first heat exchanger **110** and a first pipeline **120**. The number of first heat exchangers **110** may vary with the number of electronic components needing such cooling in the server rack. Again for the sake of easier comprehension, the drawings illustrate only one first heat exchanger **110** in each of the server racks **12** and **14**. However, the number of the electronic components and the heat exchangers are not intended to be limited this way. Because the first heat dissipation assembly **100** and the second heat dissipation assembly **200** are similarly disposed in each of the server racks **12** and **14**, only the first server rack **12** is described below.

The first heat exchanger **110** is disposed inside the first server rack **12** which is in high-conductivity thermal contact with an electronic component of the first server rack **12**. Therefore, the heat generated by the electronic component is efficiently conducted to the first heat exchanger **110**.

A first coolant **121** is inside the first pipeline **120**, and the first pipeline **120** is in thermal contact with each of the first heat exchangers **110** respectively, so that the first coolant **121** exchanges heat with each of the first heat exchangers **110** in order to transfer waste heat from the electronic component to the first heat exchangers **110**.

The first coolant **121** in this embodiment can be a liquid with a boiling point temperature between 50° C. and 60° C. under atmospheric pressure. In this embodiment and some embodiments, the first coolant **121** is an environmentally friendly refrigerant which is free of chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC). In some embodiments, the first coolant **121** is, for example, pentafluorobutane (HFC-365mfc) or 1-methoxyheptafluoropropane (HFE-7000).

The fluid driving device **130** is connected with the first pipeline **120** to drive the first coolant **121** to cycle inside the first pipeline **120** (as indicated by directions of arrows a).

The second heat dissipation assembly **200** includes a second heat exchanger **210** which is in thermal contact with the first pipeline **120**. More specifically, a portion of the first pipeline **120** for guiding the first coolant **121** to flow back from the first heat exchanger **110** to the fluid driving device **130** is in thermal contact with the second heat exchanger **210**. Accordingly, when the first coolant **121** is cycled inside the first pipeline **120**, the first coolant **121** exchanges heat with the first heat exchanger **110**, and then it exchanges heat with the second heat exchanger **210**. The second heat exchanger **210** of this embodiment is, for example, a heat dissipation assembly including heat dissipation fins and a fan. The heat dissipation fins include a plurality of parallelly arranged heat dissipation plates which are in thermal contact with the first pipeline **120**. The fan blows air at the heat dissipation plates in order to remove the heat transferred from the electronic component to the heat dissipation plates.

The second heat exchanger **210** is disposed inside the first server rack **12** and is adjacent to the first heat exchanger **110**. In other words, the distance between the second heat exchanger **210** and the first heat exchanger **110** is a lot shorter than that between the second heat exchanger **210** and the fluid driving device **130**. Therefore, because the second heat exchanger **210** is disposed adjacent to the first heat exchanger **110**, the quantity of heat generated by the electronic component can be taken away in advance in order to reduce the temperature of the first coolant **121**. More specifically, if the temperature of the first coolant **121** reaches the boiling point after the heat generated by the electronic component is absorbed by the first coolant **121**, at least part of the first coolant **121** will transform from liquid phase to vapor phase. Because the second heat exchanger **210** is disposed inside the first server rack **12**, before the first gaseous coolant **121** leaves the first server rack **12**, the first gaseous coolant **121** will transform back to liquid phase due to the heat exchange between the second heat exchanger **210** and the first gaseous coolant **121**. Thereby, the second heat exchanger **210** can shorten the distance the first gaseous coolant **121** moves inside the first pipeline **120**, and therefore, the flow resistance of the first coolant **121** encountered inside the first pipeline **120** can be reduced (because a flow resistance of a gas inside a pipeline is larger than that of a liquid inside a pipeline). Accordingly, the power output of the fluid driving device **130** can be reduced.

Furthermore, in this embodiment, because the first coolant **121** is in liquid phase under an environment of normal temperature and pressure, the first coolant **121** can be filled inside the first pipeline **120** directly under such environment.

Furthermore, the second heat exchanger **210** can also be a plate-type heat exchanger which includes a plurality of parallelly arranged heat conduction plates and at least a pipeline going through the heat conduction plates. The heat inside the pipeline can be conducted to air through the heat conduction plates, or can be exchanged with other pipelines.

Furthermore, referring to FIGS. **3** and **4**, where FIG. **3** is a flat illustration of a data center of a second embodiment, and FIG. **4** is an enlarged view of a first heat exchanger and a second heat exchanger of FIG. **3**. The differences between the second embodiment and the first embodiment lie in that, the second heat dissipation assembly **200** further comprises a second pipeline **220**, a pump **250** and a water cooling tower **270**. Here, a water cooling tower refers to a heat removal device used to transfer process waste heat to the atmosphere. In one embodiment, the water cooling tower **270** uses water evaporation to remove process heat and cool the working fluid to near the wet-bulb air temperature. A second coolant **221** is inside the second pipeline **220**. The pump **250** is connected with the second pipeline **220** for driving the second coolant **221** to cycle inside the second pipeline **220** (as indicated by directions of arrows b). The second pipeline **220** is also in high-conductivity thermal contact with the second heat exchanger **210** so that the second coolant **221** exchanges heat with the first coolant **121** at the second heat exchanger **210**. Thereby, the heat of the electronic component not only can be conducted to air through the second heat exchanger **210**, but can also be transferred to the second coolant **221** through the second heat exchanger **210**, so that the heat generated by the electronic component can be removed at a faster speed by the second heat exchanger **210**.

Furthermore, the water cooling tower **270** in this embodiment is a closed type one, a portion of the second pipeline **220** passes inside the water cooling tower **270**, and the water cooling tower **270** is able to spray water on the second pipeline **220** in order to take away the heat of the second coolant **221**. The pump **250** is able to drive the cooled second coolant **221** back to the second heat exchanger **210** for heat exchange. The water cooling tower **270** is not limited to be a closed type one, it can also be an opened type water cooling tower in some embodiments, and the second pipeline **220** is connected to the water cooling tower **270** so that the second coolant **221** can be flowed inside the water cooling tower **270** directly for cooling.

The principle of the first coolant **121** cycling and operating inside the first pipeline **120** in this embodiment is described below. Firstly, a portion of the first pipeline **120** between an exit of the fluid driving device **130** and an entrance of the first heat exchanger **110** is described herein. At this point, the first coolant **121** is under normal temperature and pressure, and the first coolant **121** is in liquid phase because its temperature has not reached a boiling point temperature.

Then, the portion of the first pipeline **120** between an exit of the first heat exchanger **110** and an entrance of the second heat exchanger **210** is described herein. The temperature of the first coolant **121** increases after the first coolant absorbs the heat released by the electronic component. More specifically, inside the first heat exchanger **110**, if the temperature of the electronic component is higher than the boiling point of the first coolant **121**, a part of the first coolant **121** will transform from liquid phase to vapor phase, so that a large quantity of heat generated by the electronic component can be taken away by the latent heat required by the phase transition. Therefore, the first coolant **121** between the exit of the first heat exchanger **110** and the entrance of the second heat exchanger **210** is in a state of coexisting liquid and gas.

Then, the portion of the first pipeline **120** between an exit of the second heat exchanger **210** and an entrance of the fluid driving device **130** is described herein. Inside the second heat exchanger **210**, because the temperature of the second coolant **221** is lower than that of the first coolant **121**, and the first coolant **121** exchanges heat with the second coolant **221** flowed through the second heat exchanger **210**, the temperature of the first coolant **121** is reduced by releasing its heat, and the temperature of the second coolant **221** is increased by absorbing the heat released by the first coolant **121**. Accordingly, all or most of the first gaseous coolant **121** can transform back to liquid phase inside the second heat exchanger **210**. Therefore, even though the first coolant **121** between the exit of the second heat exchanger **210** and the entrance of the fluid driving device **130** may still be in a state of coexisting liquid and gas, comparing with the portion of the first pipeline **120** between the exit of the first heat exchanger **110** and the entrance of the second heat exchanger **210**, almost all of the first coolant **121** in this portion is in liquid phase.

FIG. **5** is a flat illustration of a data center of a third embodiment. In order to make the first server rack **12** dissipate heat more effectively, the second heat dissipation assembly **200** further comprises an air circulating apparatus **260**. The air circulating apparatus **260** is, for example, a fan. The air circulating apparatus **260** is disposed inside the first server rack **12** driving a flow of air from outside the first server rack **12** into and through the first server rack **12** (as indicated by a direction of an arrow c) so as to reduce the temperature inside the first server rack **12**.

Referring to FIG. **6** is a flat illustration of a data center of a fourth embodiment. In order to have a better temperature reduction effect inside the first server rack **12**, the second heat dissipation assembly **200** further comprises a third heat exchanger **230** disposed at an air inlet end **261** of the air circulating apparatus **260**. In this embodiment, the third heat exchanger **230** is disposed inside the first server rack **12**. Furthermore, the third heat exchanger **230** is in thermal contact with the second pipeline **220**, and is disposed between the pump **250** and the second heat exchanger **210**. The disposing position of the third heat exchanger **230** can allow the second coolant **221** inside the second pipeline **220** to exchange heat with the third heat exchanger **230** first. Then the second coolant **221** flowed from the third heat exchanger **230** exchanges heat with the second heat exchanger **210**.

Based on the way the third heat exchanger **230** is disposed, the air extracted from outside the first server rack **12** into the first server rack **12** by the air circulating apparatus **260** will flow through the third heat exchanger **230** and exchange heat with the third heat exchanger **230**, and therefore the temperature of the air flowed into the first server rack **12** can be reduced by the third heat exchanger **230**.

FIG. **7** is a flat illustration of a data center of a fifth embodiment. In this embodiment and some embodiments, the second heat dissipation assembly **200** further comprises a fourth heat exchanger **240** disposed between the first server rack **12** and the second server rack **14**. The second coolant **221** inside the second pipeline **220** is flowed from the water cooling tower **270** to the fourth heat exchanger **240** to exchange heat, and then it is flowed back to the water cooling tower **270**. Afterwards, the water cooling tower **270** removes the heat of the second coolant **221** absorbed at an air outlet of the first server rack **12**, so that the second coolant **221** can start a cooling cycle again.

The fourth heat exchanger **240** exchanges heat with the hot air flowed out from the first server rack **12** first, and the temperature of the hot air is reduced before flowing into the second server rack **14**, so as to enhance a heat dissipation effect of air flow inside the second server rack **14**, and to prevent a waste heat output by the first server rack **12** from accumulating inside the second server rack **14**.

FIG. **8** is a flat illustration of a data center of a sixth embodiment. In this embodiment and some embodiments, where there might otherwise be insufficient time for the second heat exchanger **210** to condense most of the first coolant **121** into liquid phase, a regulating valve (not illustrated) is disposed at the second pipeline **220** for regulating the flow rate of the second coolant **221**. Furthermore, in order to ensure that the pressure inside the first pipeline **120** is not overloaded, the first heat dissipation assembly **100** can further include a liquid storage tank **140**. The liquid storage tank **140** is connected with the first pipeline **120** and the fluid driving device **130** respectively, and is disposed at the entrance of the fluid driving device **130**. Therefore, if the first coolant **121** in coexisting states of liquid and gas is stored in the liquid storage tank **140**, the first liquid and gaseous coolant **121** will be separated. Accordingly, the first gaseous coolant **121** will not flow into the fluid driving device **130**, and therefore, the damage of the fluid driving device **130** is prevented. Furthermore, as the first coolant **121** sits inside the liquid storage tank **140**, the first coolant **121** can be cooled down naturally.

According to the heat dissipation system disclosed in the abovementioned embodiments, the second heat exchanger is in thermal contact with the first pipeline in order to exchange heat, and each of the second heat exchangers is disposed inside each of the server racks respectively. Thereby, before the first gaseous coolant flowed from the first heat exchanger leaves the server rack, the second heat exchanger can exchange heat with the first coolant in advance, so as to shorten a time the first coolant maintained in vapor phase. Therefore, a distance the first gaseous coolant moves inside the first pipeline can be shortened substantially; by such a disposition of the second heat exchanger, a flow resistance the first coolant encountered can be reduced when it is flowing inside the first pipeline. Thereby, in comparing with conventional techniques, less power is required by the fluid driving device in the abovementioned embodiment, and it is already adequate to drive the first coolant to cycle inside the first pipeline.

Furthermore, when each of the server racks has one of the second heat exchangers disposed inside, and if one of the second heat exchangers is damaged, the second heat exchangers inside the other server racks can still operate in order to reduce the temperatures inside the server racks continuously, so that the electronic components will not get damaged because of the exceeding temperatures inside the server racks.

Note that the specifications relating to the above embodiments should be construed as exemplary rather than as limitative of the present invention, with many variations and modifications being readily attainable by a person of average skill in the art without departing from the spirit or scope thereof as defined by the appended claims and their legal equivalents.

What is claimed is:

1. A server rack heat dissipation system for a server rack including an electronic component, the server rack heat dissipation system comprising:

a first heat dissipation assembly, comprising:

a first heat exchanger disposed inside the server rack and being in thermal contact with the electronic component;

a first pipeline being in thermal contact with the first heat exchanger and having a first coolant; and

a second heat dissipation assembly including a second heat exchanger, a water cooling tower, a second pipeline and a pump, the second heat exchanger being disposed inside the server rack and being in thermal contact with the first pipeline, a portion of the second pipeline being in thermal contact with the second heat exchanger, and another portion of the second pipeline being disposed inside the water cooling tower, a second coolant being inside the second pipeline, and the pump being connected with the second pipeline for driving the second coolant to cycle inside the second pipeline;

wherein when the heat dissipation system is in operation, the first coolant inside the first pipeline exchanges heat with the first heat exchanger, and then the first coolant inside the first pipeline exchanges heat with the second heat exchanger; and

wherein when the heat dissipation system is in operation, the second coolant inside the second pipeline exchanges heat with the second heat exchanger, then the second coolant inside the second pipeline exchanges heat with the water cooling tower.

2. The heat dissipation system as claimed in claim **1**, wherein the second heat exchanger is a plate-type heat exchanger.

3. The heat dissipation system as claimed in claim **1**, wherein the second heat dissipation assembly further comprises a third heat exchanger, the third heat exchanger is in thermal contact with the second pipeline, the third heat exchanger is disposed inside the server rack and is disposed between the pump and the second heat exchanger; and when the heat dissipation system is in operation, the second coolant inside the second pipeline exchanges heat with both the second and third heat exchangers.

4. The heat dissipation system as claimed in claim **3**, wherein the second heat dissipation assembly further includes an air circulating apparatus, the air circulating apparatus is disposed inside the server rack and is between the electronic component and the third heat exchanger, and the air circulating apparatus is configured to generate an air current flowing from the third heat exchanger towards the first heat exchanger.

5. The heat dissipation system as claimed in claim **1**, wherein the first heat dissipation assembly further includes a liquid storage tank, and the liquid storage tank being connected between the first pipeline and an entrance end of a fluid driving device.

6. The heat dissipation system as claimed in claim **1**, wherein the electronic component has an operating temperature range, and a boiling point of the first coolant is within the operating temperature range of the electronic component.

7. A data center heat dissipation system comprising:

a first rack heat dissipation circuit, comprising:

a first pipeline carrying a first coolant;

a first heat exchanger, in thermal contact with an electronic component disposed inside a server rack and the first pipeline, for transferring heat from the electronic component to the first pipeline; and

a second heat exchanger inside the server rack, relatively proximate to the first heat exchanger and in thermal contact with the first pipeline, the second heat exchanger being adapted to remove heat from the first pipeline;

a first fluid driving device, relatively distal to the first and second heat exchangers, being adapted to circulate the first coolant through the first pipelines; and

a second rack heat dissipation circuit, comprising:

a second pipeline carrying a second coolant isolated from the first coolant, wherein the first and second coolants do not mix;

the second pipeline also being in thermal contact with the second heat exchanger for removing heat from the second heat exchanger;

a third heat exchanger in thermal contact with the second pipeline; and

a second fluid driving device relatively distal to the first and second heat exchangers circulating the first coolant through the first pipeline;

wherein when the heat dissipation system is in operation, the first coolant circulates through the first pipeline to remove heat from the electronic component and transfer it to the second heat exchanger, and the second coolant circulates through the second circuit to remove heat from the second heat exchanger and transfer it to the third heat exchanger.

8. The server heat dissipation system of claim **7**, wherein the third heat exchanger is a water cooling tower.

9. The server heat dissipation system of claim **7**, further comprising a fan for forcing a flow of cool air through the third heat exchanger.

10. The server heat dissipation system of claim **7**, wherein the first rack heat dissipation circuit comprises a plurality of first heat exchangers in thermal contact with a plurality of first pipelines and a plurality of electronic components, wherein the first pipelines are fluidly linked together, and the first fluid driving device circulates coolant through all of the first pipelines.

11. The server heat dissipation system of claim **10**, wherein the second rack heat dissipation circuit comprises a plurality of third heat exchangers, each cooled by a flow of forced air, in thermal contact with a plurality of second pipelines, wherein the second pipelines are fluidly linked together, and the second fluid driving device circulates coolant through all of the second pipelines.

12. The server heat dissipation system of claim **11**, wherein:

the system is installed in a data center comprising a plurality of server racks, each of the server racks having a plurality of rack servers;

a cooling air flow is provided through the server racks;

one of the plurality of third heat exchangers is positioned at an entrance to the air flow;

another of the plurality of third heat exchangers is positioned at exit to the air flow; and

each of one or more remaining third heat exchangers is positioned between adjacent ones of the plurality of server racks;

wherein the one or more remaining third heat exchangers remove heat from the flowing air as it flows to subsequent server racks.

13. The server heat dissipation system of claim **12**, the first rack heat dissipation circuit further comprising a liquid storage tank, for separating liquid and gaseous coolant, located upstream of the first fluid driving device, wherein the liquid storage tank is fluidly coupled to the first fluid driving device through an outlet located near a bottom of the liquid storage tank.

14. A method of removing waste heat from electronic components in a server, the method comprising:

circulating a first cooling fluid through a first heat dissipation pipeline circuit that is in thermal contact with a pair of relatively proximately located first and second heat exchangers, the first heat exchanger being in thermal contact with an electronic component, the first rack heat dissipation circuit including a first fluid driving device located relatively distal of the pair of first and second heat exchangers;

circulating a second cooling fluid through a second heat dissipation pipeline circuit that is in thermal contact with the second heat exchanger, the second cooling fluid removing heat from the second heat exchanger, wherein the second heat dissipation pipeline circuit is in thermal contact with a third heat exchanger;

circulating the second cooling fluid through the third heat exchanger; and

forcing a flow of air over the third heat exchanger to remove heat from the third heat exchanger.

15. The method of claim **14**, wherein the first heat dissipation pipeline circuit is in thermal contact with a plurality of pairs of relatively proximately located first and second heat exchangers, the first fluid driving device circulating the first cooling fluid through all of the pairs of first and second heat exchangers.

16. The method of claim **15**, wherein the second heat dissipation pipeline circuit is in thermal contact with each of the second heat exchangers, the second heat dissipation pipeline circuit having a second fluid driving device, the second fluid driving device circulating the second cooling fluid through all of the second heat exchangers.

17. The method of claim **16**, wherein the second heat dissipation pipeline circuit is in thermal contact with a plurality of third serially arranged heat exchangers, the method further comprising forcing a flow of air over the serially arranged third heat exchangers to transfer and dissipate heat from the second cooling fluid.

18. The method of claim **14**, further comprising:

selecting a first cooling fluid having a boiling point that is within an operating temperature range of the electronic component;

transferring heat away from the electronic component primarily through a transition from a liquid phase to a gas phase; and

transferring a sufficient amount of heat from the first cooling fluid to the second heat exchanger to re-transition most of any gaseous phase of the first cooling fluid back into a liquid phase.

* * * * *